CLAIMS

Therefore, having thus described the invention, at least the following is claimed:

Sub A'

1. ~~A soil and~~ groundwater decontamination system ~~for decontaminating~~ a contaminated subsurface zone, the contaminated subsurface zone having a groundwater level below which is a groundwater (saturated) zone and above which is a vadose zone, the vadose zone and the groundwater level having a capillary fringe therebetween, comprising:

a product having the ability to react with subsurface contaminants and create a reaction end product;

an injection well, said injection well having a length, said injection well being disposed in the contaminated subsurface zone, said injection well configured to introduce said product into the contaminated subsurface zone;

a well casing having a proximal end, a distal end, a length therebetween, and a lateral wall, said distal end of said well casing being disposed in said contaminated subsurface zone;

a drop tube, said drop tube having a proximal end, a distal end, a length therebetween, and a lateral wall, said drop tube being disposed inside and extending along said well casing, said drop tube configured to extract reaction end products from the contaminated subsurface zone and contaminants from the contaminated subsurface zone; and

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a vacuum pump, said vacuum pump being in fluid communication with said proximal end of said drop tube.

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2. The soil and groundwater decontamination system of claim 1, further comprising:

a catalyst, wherein said product and said catalyst are combined as said product and said catalyst are injected into the contaminated subsurface zone.

3. The soil and groundwater decontamination system of claim 1, further comprising:

a catalyst, wherein said product and said catalyst are combined before said product and said catalyst are injected into the contaminated subsurface zone.

4. The soil and groundwater decontamination system of claim 1, further comprising:

a catalyst, wherein said product and said catalyst are combined after said product and said catalyst are injected into the contaminated subsurface zone.

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5. The soil and groundwater decontamination system of claim 1, further comprising:

a phase separator for separation of liquid and gas extracted in multiple phases, such as the gas phase and the liquid phase.

6. The soil and groundwater decontamination system of claim 1, further comprising:

a contaminant filter, said contaminant filter being in fluid communication with said drop tube, wherein said contaminant filter configured to treat extracted groundwater and vapor products to produce an environmentally suitable product.

7. The soil and groundwater decontamination system of claim 1, further comprising:

a fluid pump, said fluid pump providing said product to said injection well.

8. The soil and groundwater decontamination system of claim 1, further comprising:

a supply valve, said supply valve being variable and in fluid communication with said well casing.

9. The soil and groundwater decontamination system of claim 1, wherein said lateral wall of said injection well includes a screen.

10. The soil and groundwater decontamination system of claim 1, wherein said lateral wall of said injection well includes perforations.

11. The soil and decontamination system of claim 1, wherein said well casing is closed at said distal end.

12. The soil and decontamination system of claim 1, wherein said drop tube is open at said distal end.

13. The soil and decontamination system of claim 1, wherein said lateral wall of said drop tube includes at least one opening.

14. The soil and decontamination system of claim 1, wherein said distal end of said injection well is disposed in a vadose zone of the contaminated subsurface zone.

15. The soil and decontamination system of claim 1, wherein said distal end of said injection well is disposed at a groundwater level of the contaminated subsurface zone.

16. The soil and decontamination system of claim 1, wherein said distal end of said injection well is disposed below a groundwater level of the contaminated subsurface zone.

17. The soil and decontamination system of claim 1, wherein said distal end of said well casing is disposed in a vadose zone of the contaminated subsurface zone.

18. The soil and decontamination system of claim 1, wherein said distal end of said well casing is disposed at a groundwater level of the contaminated subsurface zone.

19. The soil and decontamination system of claim 1, wherein said distal end of said well casing is disposed below a groundwater level of the contaminated subsurface zone.

20. The soil and decontamination system of claim 1, wherein said distal end of said drop tube is disposed in a vadose zone of the contaminated subsurface zone.

21. The soil and decontamination system of claim 1, wherein said distal end of said drop tube is disposed at a groundwater level of the contaminated subsurface zone.

22. The soil and decontamination system of claim 1, wherein said distal end of said drop tube is disposed below a groundwater level of the contaminated subsurface zone.

23. The soil and groundwater decontamination system of claim 1, wherein said product is further defined as an oxidizing agent.

24. The soil and groundwater decontamination system of claim 1, wherein said product is further defined as a surfactant.

25. The soil and groundwater decontamination system of claim 1, wherein said product is further defined as a co-solvent.

26. A soil and groundwater decontamination system for decontaminating a contaminated subsurface zone, the contaminated subsurface zone having a groundwater level below which is a groundwater (saturated) zone and above which is a vadose zone, the vadose zone and the groundwater level having a capillary fringe therebetween, comprising:

a product having the ability to react with subsurface contaminants and create a reaction end product;

an injection well, said injection well having a length, said injection well being disposed in the contaminated subsurface zone, said injection well configured to introduce said product into the contaminated subsurface zone;

a well casing having a proximal end, a distal end, a length therebetween, and a lateral wall, said distal end of said well casing being disposed in said contaminated subsurface zone;

a drop tube, said drop tube having a proximal end, a distal end, a length therebetween, and a lateral wall, said drop tube being disposed inside and extending along said well casing, said drop tube configured to extract reaction end products from the contaminated subsurface zone and contaminants from the contaminated subsurface zone; and

a vacuum pump, said vacuum pump being in fluid communication with said proximal end of said drop tube.

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27. A soil and groundwater decontamination system for decontaminating a contaminated subsurface zone, the contaminated subsurface zone having a groundwater level below which is a groundwater zone and above which is a vadose zone, the vadose zone and the groundwater level having a capillary fringe therebetween, comprising:

a product supply means;

a means for introducing said product into a contaminated subsurface zone, said product being able to react with the subsurface contaminants and produce a reaction end product;

a vacuum means;

an extraction means, said extraction means being in fluid communication with said vacuum means, said extraction means extracting the reaction end products from the contaminated subsurface zone and contaminants from the contaminated ~~subsurface~~ zone.

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~~28. A soil and groundwater decontamination method for decontaminating a~~ contaminated subsurface zone, the contaminated subsurface zone having a groundwater level below which is a groundwater zone and above which is a vadose zone, the vadose zone and the groundwater level having a capillary fringe therebetween, comprising the steps of:

introducing a product into a contaminated subsurface zone, said product having the ability to react with subsurface contaminants;

allowing said product to react with said contaminants, thereby producing a ~~reaction end product;~~

disposing a well casing having a proximal end and a distal end into the contaminated subsurface zone;

disposing a drop tube inside said well casing, said drop tube having a proximal end and a distal end corresponding to said proximal end and said distal end of said well casing, respectively;

producing a vacuum in said drop tube; and

extracting the reaction end product from the contaminated subsurface zone and contaminants from the contaminated subsurface zone.

29. The soil and groundwater decontamination method of claim 28, further comprising the step of:

introducing a catalyst into a contaminated subsurface zone, said catalyst facilitating a reaction between the product and contaminants in the contaminated subsurface zone.

30. The soil and groundwater decontamination method of claim 29, wherein said steps of introducing a catalyst and introducing a product are done simultaneously.

31. The soil and groundwater decontamination method of claim 29, wherein said step of introducing a catalyst is done before the step of introducing a product.

32. The soil and groundwater decontamination method of claim 29, wherein said step of introducing a catalyst is done after the step of introducing a product.

33. ~~The soil and groundwater decontamination~~ system of claim 28, further comprising the step of:

separating liquid and gas being extracted in multiple phases, such as the gas phase and the liquid phase.

~~34. The soil and groundwater decontamination system of claim 28, further~~ comprising the step of:

providing a filter, said filter being in fluid communication with said drop tube, wherein said filter treats extracted groundwater and vapor products to produce an environmentally suitable product.

~~35. The soil and groundwater decontamination system of claim 28, further~~ comprising the step of:

supplying fluid to said well casing said step of supplying fluid being variable

~~36. The soil and groundwater decontamination method of claim 28, wherein~~ said product is introduced into a vadose zone of the contaminated subsurface zone through at least one conduit extending into the vadose zone.

37. The soil and groundwater decontamination method of claim 28, wherein said product is introduced at a groundwater level of the contaminated subsurface zone through at least one conduit extending to the groundwater level.

38. The soil and groundwater decontamination method of claim 28, wherein said product is introduced below a groundwater level of the contaminated subsurface zone through at least one conduit extending below the groundwater level.

39. The soil and groundwater decontamination method of claim 28, wherein said distal end of said well casing is disposed in a vadose zone of the contaminated subsurface zone.

40. The soil and groundwater decontamination method of claim 28, wherein said distal end of said well casing is disposed at a groundwater level of the contaminated subsurface zone.

41. The soil and groundwater decontamination method of claim 28, wherein said distal end of said well casing is disposed below a groundwater level of the contaminated subsurface zone.

42. The soil and groundwater decontamination method of claim 28, wherein said distal end of said drop tube is disposed in a vadose zone of the contaminated subsurface zone.

43. The soil and groundwater decontamination method of claim 28, wherein said distal end of said drop tube is disposed at a groundwater level of the contaminated subsurface zone.

44. The soil and groundwater decontamination method of claim 28, wherein said distal end of said drop tube is disposed below a groundwater level of the contaminated subsurface zone.

45. The soil and groundwater decontamination method of claim 28, wherein said extraction step extracts vapor.

46. The soil and groundwater decontamination method of claim 28, wherein aid extraction step extracts liquid and vapor.

47. The soil and groundwater decontamination method of claim 28, wherein said extraction step extracts liquid.

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48. The soil and groundwater decontamination method of claim 28, wherein said step of allowing said product to react and said step of producing a vacuum are done simultaneously.

49. The soil and groundwater decontamination method of claim 28, wherein said step of allowing said product to react is done before said step of producing a vacuum.

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50. The soil and groundwater decontamination method of claim 28, wherein said step of allowing said product to react is done after said step of producing a vacuum.

51. The soil and groundwater decontamination method of claim 28, wherein said step of introducing a product is further defined as introducing an oxidizing agent.

52. The soil and groundwater decontamination method of claim 28, wherein said step of introducing a product is further defined as introducing a surfactant.

53. The soil and groundwater decontamination method of claim 28, wherein said step of introducing a product is further defined as introducing a co-solvent.